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Reading Ability in Signing Deaf Children

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Abstract

This article reviews three types of claims proposing that knowledge of American Sign Language facilitates reading development in deaf children. Arguments will be presented in support of a refinement of one such claim: That there is a relationship between ASL competence and reading. We argue that the relationship does not develop "naturally" but must be cultivated. There are conditions that enable associations to be made between ASL and reading including exposure to certain types of discourse settings that serve to highlight, signify and direct attention to correspondences between different language systems.

Key words: American Sign Language, fingerspelling, initialized signs, reading, deaf students, deaf teachers, hearing teachers, residential school, orthography

The recent new attention directed to relationships between reading and American Sign Language (ASL) follows from a body of work demonstrating relationships between early exposure to sign language and normal development of language and cognitive skills. Newport and her colleagues (1990) have found that deaf adults who acquire ASL early in life are able to make consistent judgments of ASL morphology unlike those who acquired it later in life, demonstrating that native competence in a natural language requires exposure to the language during the first few years of life. The effect extends to other non-linguistic cognitive skills, as those with earlier exposure to ASL are likely to perform successfully on a variety of measures of cognitive skills including memory and sequencing compared to those who were exposed to a primary language later in their childhood (Mayberry & Fischer, 1989).

Since reading is generally viewed as a skill drawing upon a collection of cognitive abilities, including memory and linguistic ability (Adams, 1990; Gathercole & Baddeley, 1993) several studies have asked whether early and consistent exposure to ASL might also support reading development in the deaf. Some preliminary work has suggested such a relationship: Moores and Sweet (1990) found that as a group deaf adolescents of deaf parent performed somewhat better than a comparison group of "total communication" students on the reading comprehension subtest of the Stanford Achievement Test, normed for hearing impaired students (SAT-HI). However they also report that "ASL proficiency," which they measured as a global function through a language proficiency Interview, is not a predictor of either reading or writing ability in this group. Mayberry (1989) likewise found a relationship, with children of deaf parents

outperforming children of hearing parents on the reading comprehension subtest of the SAT-HI. But these studies of relationships between having deaf parents and reading ability do not specify whether the outcomes are due to knowledge of ASL specifically, or whether factors that co-occur with presence of early exposure to ASL contribute to reading performance.

There are at least two non-linguistic accounts of why a relationship between ASL and reading ability might exist. First, having deaf parents and growing up in a generally accepting environment might by itself provide sufficient conditions for reading development. Deaf parents are more accepting of their child's handicap (Schlesinger & Meadow, 1972), less traumatized by the presence of deafness in the family and are able to focus parental and family resources to their child's early language development. Furthermore, deaf parents are more likely to detect deafness in their children at an earlier age and because of familiarity with schooling options for deaf children, are more likely to introduce them to school earlier (Padden, in press, a). Thus, earlier and longer exposure to schooling and reading instruction plus other related factors, not specifically ASL, might be among the predictors of reading development in deaf children.

A second possible account for the relationship between ASL and reading is that deaf children of deaf parents do well only because the pool of deaf children of hearing parents is so variable. Deaf children of hearing parents includes those whose recognition of deafness in some cases takes place as late as age 2 years, leading to late introduction to education which may impact the development of a variety of skills necessary for reading development. By comparison, deaf children of deaf parents who have generally more consistent sign language backgrounds appear better because the minimal conditions for reading acquisition are present. They

have exposure to a first language, and this serves as a general launching pad for the development of other language skills. Because there are few studies comparing deaf children of deaf parents with age-matched hearing readers of similar social backgrounds, it is hard to tell whether it is ASL specifically that contributes to reading development, or early language experience in general.

A third account, one based on linguistic factors, has recently been advanced: Deaf children of deaf parents acquire reading ability because they possess skill in a natural language, ASL. In this account, the argument is that ASL is sufficiently rich as a language system that it can provide a foundation for acquisition of another language skill. At first glance, this account of reading development in this population seems weak. In the conventional sense, reading involves associating sound with symbol, or, learning how to segment the speech signal into elements that can be associated with alphabetic characters (Adams, 1990). The task seems impossibly difficult in the case of ASL and reading. How might two very dissimilar systems be brought together in such a way that written symbols can come to have meaning? Sign languages are composed of gestural units that have no correspondence to spoken languages; alphabetic systems are based on phonemes of a spoken language. Furthermore, there are no sign languages with written systems, so the possibility of transfer of reading skill from one writing system to another does not seem viable.

This article will present a series of arguments for a refinement of the third account. Evidence will be presented demonstrating that there is a relationship between ASL and reading, but the relationship instrumentally involves associations between specific elements of ASL and the alphabetic writing system. Crucially, it will be argued that the associations must be cultivated. Though the associative elements

are present in ASL, they do not “naturally” link with written language. That is, the argument is that reading skill among signing deaf children is not due to general knowledge of ASL, but instead, to knowledge of cultivated associations between ASL and written language. For the latter knowledge to develop, there must be conditions that enable these associations to be made and that provide sufficient practice in forming these associations. These conditions, as will also be argued, derive from resources external to the individual, that is, they are found in social practices among deaf readers and in instructional techniques used by signing teachers.

Foundations of reading skill

In a recent review of reading research, Adams (1990) reiterates that reading is not a single skill, but “a whole complex system of skills and knowledge” (p. 3). She describes these skills as the ability to recognize words in print “quickly, accurately and effortlessly” and to associate them with the larger meaning of the text. For very young children who are beginning the task of reading, two strong early predictors of eventual success in reading stand out: the ability to name letters quickly and accurately, and the presence of phonemic awareness (specifically, the ability to associate sounds with letters). Once these early skills are in place, the child can begin the task of associating two systems, the spoken language and its written representation. The nature of that task when the written system is an alphabetic one is to form an association between a sound unit, specifically, a phoneme, and the alphabetic character. Children who are at risk of facing reading difficulty are those who struggle to segment the spoken word into smaller units.

In addition to the decoding task, learning to read also involves extrapolating meaning from words and sentences in print. Decoding letters and blending them

into words is not sufficient; the words must have meaningful content to the reader. While recognizing that reading involves orchestrating many complex skills in an efficient way, Perfetti (1985) describes reading as fundamentally based on the skill of recognizing the orthographic form and understanding its meaning. The developing reader may at first need to "sound out," or form immediate associations between sound and symbol, but as reading becomes more fluent and automatic, the reader directly recognizes the orthographic form.

Though traditional reading research does not often mention social environments that support these early skills, or their development into mature reading ability, Adams (1990) emphasizes that reading is not a "naturally" acquired skill. Certain home environments seem to support development of these skills more than others. For example, in homes where families sing nursery rhymes, children practice in phoneme manipulation and segmentation (Maclean, Bryant & Bradley, 1987). In families where books are a central tool of everyday life children are more likely to be asked to practice letter recognition, "sounding out" and identifying words in print (Teale, 1984; 1986). Adams argues that learning to read involves a great deal of practice, and many hours informally devoted to the task of learning to about words in print. Heath (1983) takes the view that it is not merely hours of practice that fosters reading ability, but also in the ways in which reading and writing are signified and privileged in middle-class homes. Children from such families often seem to ease into learning to read.

Reading difficulty in deaf children

Surveys of reading ability in deaf children report difficulty, with average reading achievement at levels well below age-matched hearing peers (Karchmer, Milone & Wolk, 1979; Allen, 1986; Holt, 1993). From these surveys, the general finding is that

the greater the hearing loss, the more likely the individual will have reading difficulty which supports the view that hearing loss contributes to reading difficulty. But as Conrad (1979) pointed out, hearing loss by itself does not predict reading ability. He found that the predictors of reading success were high measured intelligence and the ability to use "inner speech." Conrad defined "inner speech" as the ability to rehearse internally in vocal-like form while attempting to remember words in print. Conrad's finding is supported by other studies with adult deaf readers (Hanson & Fowler, 1987; Hanson, Goodell & Perfetti, 1991; Waters & Doehring, 1991) which show that among the group of deaf readers, most demonstrate phonemic awareness while reading despite the presence of deafness.

One variable that predicts reading success in profoundly deaf children has emerged: having deaf parents. In Conrad's survey of 468 deaf and hard-of-hearing children, he found only five profoundly deaf readers who were reading at age level. Two had deaf parents (1979:175). Mayberry (1989) using a population of 36 children, half of whom had deaf parents, found a correlation between reading performance and deaf parents. Using a larger population of 98 deaf children from ages 6 to 15, we found a significant correlation between having deaf parents and performance on the SAT-HI, reading comprehension subtest ($R = .39, p < 0.01$) (Padden, in press, a). However, we also found that deaf children of deaf parents were more likely than deaf children of hearing parents to share characteristics that support reading achievement in this population: early detection of deafness, entering school earlier and having longer tenure in school.

Though enticing, correlations between deaf parents and reading ability do not obviously point to specifically linguistic bases of reading success in deaf children, though it would certainly be logical to argue that what deaf children of deaf parents

have in common is not only deaf parents, but early exposure to ASL. As stated earlier, the relationship between ASL and reading skill is not an obvious one. It cannot be the case that simply knowing ASL leads to reading development, as it cannot be the case that simply knowing English leads to reading development. Many young hearing speakers of English struggle to learn to read despite native competence in English. Instead, claims about these associations must be specific and refer to both conditions of upbringing as well as sets of knowledge that precede and contribute to reading development. Stated another way, it cannot be the case that if a child acquires ASL, the child will also acquire the ability to read English. Even if a child is highly skilled in ASL, it is not necessarily the case that the child will be especially favorably positioned to learn to read. A priori, there is no reason to expect these two kinds of language competence to co-vary. Instead, we argue, it must be the case that English reading skills develop from association with specific skills in ASL. Then it must be shown how these associations are cultivated in home and classroom contexts to bring about reading development. In the study which we report here, as well as work of our colleagues, Prinz & Strong (in press) and Singleton (in press), these issues are addressed.

Interrelationships of language skill and reading ability

This article reports on a study developed specifically to explore relationships between ASL and reading skill. Since correlations between ASL and reading achievement establish only that the two have a relationship and not which elements of ASL relate to reading development, the study went beyond the global measures of ASL competence such as having deaf parents, or performance in a language interview, and looked at specific language skills that might co-vary with ASL and reading skill. Two candidates emerged: fingerspelling and initialized signs.

Fingerspelling is a likely candidate because it is frequently present in the language environment of signing deaf children, and its form derives from a representation of English orthography. Ethnographic studies of deaf families show that deaf parents not only use fingerspelling in everyday conversation with each other and their children, they also use fingerspelling in literacy activities (Maxwell, 1984; Kelly, 1995). While fingerspelling, signers produce distinctive hand configurations and small movements which correspond with letters of the alphabet, constructing manual equivalents of words in print. There is no real equivalent in spoken English. Spelling out loud is rare in English not conventional and routine as fingerspelling in ASL. In a recent measure, fingerspelled items were found to consist of approximately 15% of all manual vocabulary in signed discourse (Padden, 1998).

Initialized signs likewise derive from English orthography via fingerspelling, but the representation is greatly reduced. Their morphological form involves use of a fingerspelled handshape incorporated in the sign which coincides with the first letter of its English translation. Initialized signs can stand in contrast to a non-initialized counterpart, e.g. the ASL sign BOX has an initialized counterpart, ROOM, which incorporates the R fingerspelled handshape. This contrast is often exploited in instructional settings where parents and teachers purposely make distinctions between ASL signs and English words. An example captured on a videotape of an elementary classroom was a teacher's distinction between LAND-AREA and GARDEN, with the second sign initialized but not the first. The teacher wanted specifically to cue the English word "garden" during a spelling test, rather than a range of translations for "an area of land."

Despite their relationship to English orthography, the literature is not clear as to the roles of fingerspelling and initialized signs in reading development. Treiman & Hirsh-Pasek (1983) found little evidence that fingerspelling was used by young deaf children of deaf parents to rehearse print words while attempting to remember them. Likewise, Hanson & Fowler (1987) found that skilled adult deaf readers were more likely to be confused by words in print that sounded alike than those that were fingerspelled alike, demonstrating that if deaf readers rehearsed words in print in order to remember them, they were not likely to use fingerspelled codes. But these tasks involved memory of lists of words in print. Reading competence involves multiple skills of which rehearsal in memory is only one. Automatic recognition of words via their orthographic form is also critical (Adams, 1990). Seidenberg & McClelland (1989) have argued that reading skill involves the ability to instantaneously recognize orthographic sequences; words or segments with highly familiar orthographic sequences are more easily accessed than less familiar sequences. If fingerspelling has a role in reading, it is possible that its role is to expose young deaf children to orthographic regularities which are then expanded to include their counterparts in print. But the precise relationship between these representational forms and English has yet to be mapped.

The role of initialized signs is much less understood. Their correspondence to print is not as direct as that of fingerspelled words; only the first letter of the English translation is available from the sign. But because literacy activities of deaf parents and signing teachers often use initialized signs as ways of highlighting contrasts between ASL signs and their English translations, the study was directed to an exploration of what role these vocabulary might play in reading development.

Testing relationships among language skills

A set of tasks were developed that would test for ASL competence as well as their ability to exploit fingerspelling and initialized signs to retrieve and write English words. The tasks were administered to thirty-one deaf children who were attending one of four classrooms included in our study: a fourth grade class for deaf children in a public school (n=7), a fourth grade class for deaf children in a residential school (n=10), a seventh-eighth grade class for deaf and hard of hearing children in a public middle school (n=6), and a seventh grade class in a residential school (n=8).¹ The mean age of fourth graders was 8.4, and seventh-eighth graders, 11.9. Six of the fourth graders and 5 of the seventh graders are female. All are profoundly deaf.

The public elementary and middle schools where these deaf students are enrolled are located in the same school district. The schools are targeted for deaf children in the district because they offer special classes for them. The programs describe themselves as promoting a "total communication" educational philosophy in which different modes of communication may be used by teachers. The residential school enrolls elementary, middle and high school students on the same campus and advocates a "bilingual" approach where ASL is afforded a prominent role in the school curriculum and in the classrooms. The two school settings are located in the same state though at great distance from one another.²

As measures of ASL competence, two tests were used from a battery developed designed to measure skill in ASL morphology and syntax (Supalla et al, in press). The first, Verb Agreement Production, tests the ability to produce a correctly inflected verb form in ASL. Since ASL has several verb classes, each with a different inflectional pattern (Perlmutter & Askins, 1995) selecting the correct

inflection is a measure of ASL competence. In the second, Sentence Order Comprehension, students observe a sentence in ASL and select the picture that correctly identifies the subject and object of the sentence. In addition, a third test was developed which measured memory for ASL sentences. Students were asked to watch a sentence in ASL and to repeat it as nearly as possible. Following Mayberry & Fischer (1989) who found that individuals with less competence in ASL were more likely to make formational (similar sign) rather than semantic (similar meaning) errors, the test was scored according to the student's ability to repeat the sentence correctly and the type of error made.

As measures of the ability to recognize English counterparts of fingerspelled words and initialized signs, two tests were devised. The first, a fingerspelling test, asked students to view a sentence signed on videotape containing a fingerspelled word. After the sentence, the student saw a question prompting the fingerspelled word and they were asked to write the word in English. To be scored correct each word had to be correctly spelled. On the initialized signs test, students watched a videotaped sentence containing an initialized sign. The sign was repeated at the end of the sentence and students were asked to write the English translation. Only initialized signs used among ASL signers were chosen for inclusion; none represented functor words, or copulas and articles that are found in the pedagogical "signed English" systems. The aim was not to evaluate skill in any pedagogical tool, but to explore the student's knowledge of English translations of frequently used initialized signs in ASL. Answers were scored on a weaker standard; if the word was not spelled correctly, it was accepted as correct if three independent, naive raters identified the target word from the incorrect written attempt.

The student's most recent SAT-HI, reading comprehension subtest score was used as a measure of reading ability. This test was administered by the schools and made available to us by parental consent.

Results

ASL and reading ability

On our battery of three ASL tests, Imitation, Verb Agreement Production and Sentence Order Comprehension, all correlated with reading comprehension, suggesting that ASL skill and reading skill have a relationship in at least certain populations of deaf children. Further, these correlations hold across deaf students with hearing and deaf parents. Within the ASL measures, only the Imitation task correlated with having deaf parents ($R = .53, p < .01$). The Verb Agreement Production and Sentence Order Comprehension tasks were apparently not powerful enough to distinguish native signers in the study ($R = .29$; $R = .22$, respectively) although all three ASL tasks are highly correlated with each other. As noted in another study (Padden, in press, a) using a larger population of 98 children, a strong association was found between having deaf parents and SAT-HI reading comprehension subtest scores.

- Table 1 -

ASL and fingerspelling

Deaf students who demonstrated skill in ASL, as measured by the ASL tests, also performed well on the fingerspelling test, indicating that as ASL skills increase, fingerspelling skills are likely to increase as well. We did not find a significant association between having deaf parents and performing better on the task, rather skill on ASL tasks predicted performance on the Fingerspelling task.

As part of our population of deaf students, there were some who were late learners of sign language, a group that included several who entered school late (e.g. one child, a recently arrived immigrant, did not begin formal schooling until the age of 9 years). These were students who had the greatest difficulty on the task. The weaker signing students struggled with even the shorter words in the task, e.g. words like 'wax,' or 'bark.' They missed letters, sometimes all of them, or could not retain the order of letters in the word. The handshapes of fingerspelled words in ASL are executed quite rapidly, and it takes skill to be able to recognize them accurately, as any adult ASL second-language learner can testify. Students with good performance on ASL tests were those who performed better on the fingerspelling task.

-Table 2 -

ASL and initialized signs

Skill on the Initialized signs task and fingerspelling are highly correlated, which suggests that they are related to each other. Additionally, scores on the Initialized signs test correlated highly with the ASL measures. Again this suggests that, as hypothesized, this group of tasks is interrelated. As with the Fingerspelling task, we did not find a relationship between this skill and deaf parents. Possibly the small presence of students with deaf parents in this sample of deaf students (n=8) made it difficult to discern relationships. Instead, these correlations suggest more broadly that skill in in fingerspelling and initialized signs is related to skill in ASL, a finding that raises a number of questions about the nature of fingerspelling and initialized vocabulary. These forms are traditionally viewed as deriving from English vocabulary and grammar, but our results show that use of these forms may require knowledge of ASL structure as well.

-Table 3-

Associations among language skills

Next, relationships among the two specific language skills of interest, fingerspelling and initialized signs, and measures of reading ability. First, a relationship was found between fingerspelling skills and reading skills. Deaf students who performed well on the fingerspelling test also scored better on the SAT-R. This holds true regardless of parent status.

This finding, while suggesting a relationship, does not specify its nature. Does fingerspelling ability precede reading ability, that is, must the child already know how to read in order to recognize a fingerspelled word? It appears not. Studies of fingerspelling in deaf families report that young deaf children can recognize fingerspelled words before they can read print which would suggest that recognition is possible without reading ability (Padden, 1991; Kelly, 1995), but the same studies describe young deaf children's production of novel fingerspelled words as delayed until much later, coinciding with early reading development. From descriptions of how young deaf children recognize fingerspelled words (Akamatsu, 1982), it appears that they first learn to recognize fingerspelled words as global, whole units, not in terms of the composition of individual handshapes that make up the letter sequence in the word. Only later do they recognize handshapes and their correspondence with letters.

The fact that the task required students to write the words after recognizing them meant that written language skill was involved. But the precise relationship between fingerspelling and reading or writing in the signing child has yet to be

mapped. Does fingerspelling make reading and writing possible? Or do reading and writing make fingerspelling possible? Or, is the relationship a reciprocal one in which fingerspelling facilitates letter recognition and then after basic letter recognition, reading ability makes recognizing fingerspelled words possible? A logical next project would examine this relationship more deeply, testing for recognition of familiar and novel fingerspelled words and then separately, for the ability to write them in print. The goal is to uncover early fingerspelling skills which may serve as important precursors to reading and track them over the course of reading development in this population of readers.

Second, there was a relationship between reading ability and the initialized signs test. Because initialized signs give only one clue to their English print counterparts, that is, the first letter of the English translation, students need to know the full word in order to answer correctly. Indeed, many students responded by writing the first one or two letters of the word, then their writing trailed off. In order to complete the task, students need to know the correct translation and how to spell it at least closely enough to be identified as the word.

- Table 4 -

In the context of studying reading skills in signing deaf children, ASL ability needs to be described in a specific way. Instead of broad assessments of functional ability during conversation, this study identifies two likely language skills both of whose roots are traced to the English alphabetic writing system. Both appear to be good candidates for associative skills, or those skills which allow associating two dissimilar systems, in this case, a natural language and a written system. In the case of oral languages, sounding out or reading aloud perform associative functions, as

a mediating level between speech and print. In the case of signed language, it appears that fingerspelling and initialized signs perform a similar function.

It needs to be clarified here unequivocally that because the study finds associative elements between ASL and the English writing system, it does not by the same token regard ASL as "English." Though fingerspelling and initialized signs have elements which derive from the written system, their use is deeply embedded in natural everyday ASL (Padden, 1998; Padden, in press, b). Instead, their significant role derives from the fact that ASL signers have over time developed conscious and unconscious strategies for learning to read which involve deploying elements of their language for the purpose of forming associations between their primary language and a written representation of a neighbor language. Crucially, it is not claimed here that fingerspelling or initialized signs by themselves afford reading ability. Indeed, many students could fingerspell or produce initialized signs, but only a subset could demonstrate they understood the relationship between these words and their counterparts in print. Instead, it is argued that deaf readers must *learn* to exploit fingerspelling and initialized signs as tools for reading, and must have guided practice doing so. They learn to do this, as argued, from teachers and from other signing deaf readers in homes and in instructional contexts that where the set of skills needed to become a "signing deaf reader" is implicitly acknowledged.

Developing associative skills

At least two settings might provide data to bolster the claim that the ASL skills that support reading skill are cultivated: home environments and classrooms. This study was exclusively a school study, and does not include home data. However, two kinds of school-based data proved both instructive and suggestive. The

classroom-based analyses includes examination of teacher discourse patterns, as well as descriptions of deaf children's reading strategies.

Patterned teacher discourse

For a study of the discourse patterns that emerge as signing teachers provide reading instruction to deaf children, we sampled 90 hours of videotaped data from six classrooms involving 7 teachers. Six 15-minute segments were selected for each teacher from the first fifteen minutes of teacher-initiated lessons.

The seven teachers in the study represent the mix of backgrounds and characteristics found in deaf education. Three teachers were selected from public school classroom data. Four were selected from the residential school. Three of the teachers (one from the public school district and two from the residential school) are native signers. Four of the teachers (two from the public school district and two from the residential school) are non-native signers. Three of the teachers are deaf (one from the public school district and two from the residential school) and four are hearing (two from the public school district and two from the residential school). Included in this group as a hearing teacher who has deaf parents.

- Table 5 -

Two facts stand out in the range of language patterns employed by the teachers. First, deaf teachers fingerspelled more than twice as often as hearing teachers. Deaf teachers fingerspelled an average of 176 words (including repetitions of the same word) across all samples. The hearing teachers, on the other hand, fingerspelled much less, an average of 75 words. Furthermore, residential school teachers fingerspelled an average of 152 words compared to public school teachers' average

of 74 words. Within the public school setting, the deaf teacher, who acquired ASL as a teenager, accounted for more instances of fingerspelling than the two hearing teachers combined. Within the residential school group of teachers, although one deaf teacher had a very large number of instances of fingerspelling, there is little difference between the second deaf teacher and the two hearing teachers.

Second, the teachers who fingerspell often also tend to repeat the same fingerspelled word several times throughout a segment. Very often fingerspelling was used in what has been described elsewhere as "chaining" structures (Humphries & MacDougall, 1997). Chaining is a technique used by some teachers to form a relationship between a sign, a printed word, and a fingerspelled word. In this technique, a teacher might, for example, fingerspell a word, then immediately point to the same word printed on the blackboard, and fingerspell the word again. Or, a teacher might produce a sign and then fingerspell its English translation immediately after. This technique seems to be a process for emphasizing, highlighting, objectifying and generally calling attention to equivalences across texts and languages. Kelly (1995) finds that deaf parents in home environments use a similar technique, forming what she calls "sandwiches," as they insert a fingerspelled word or a pointing gesture between a sign repeated twice. The function in the home is likewise to draw attention to an object and its correspondence to a sign and/or a fingerspelled word.

The sampled teachers varied in their use of the chaining technique. Some teachers used a great deal of chaining during instruction, while others used it very little or not at all. Deaf teachers used an average of 30 instances of chaining while hearing teachers used chaining an average of 5.5 times. Residential school teachers used

chaining an average of 21.5 times and public school district teachers an average of 8.7 times.

- Table 6 -

It might be expected that fluency in ASL accounts for some of the differences between deaf and hearing teachers with respect to fingerspelling and chaining since these are structures that appear commonly in everyday ASL. That is, a signer's use of these discourse patterns might grow from her personal characteristics, rather than her style of teaching deaf children or her training. But not entirely. A native signer teaching in a public school in this study was observed using little chaining and hearing teachers in the residential school using more fingerspelling and chaining compared to their counterparts in the public schools. Hence, in addition to features of a teacher's personal history, where she teaches also contributes to her classroom practice. It is clear that residential schools and public school programs differ, especially in the number of students (Schildroth, 1988) and in student demographic characteristics. In our population, deaf parents exhibited a preference for the residential school. The public schools, on the other hand, served a smaller but very mixed group that included recent immigrant children, children with frail health, and more ethnic minority students than the residential school.

Accordingly, it is hypothesized that school environments engender certain types of teaching and teaching techniques. Or alternatively, teachers who possess these techniques to begin with select the type of school setting where they are encouraged to make use of them.

As tantalizing as these observations might be, there is no claim at this time as to whether greater use of fingerspelling and chaining are more effective in teaching

reading. In fact, to the extent that these strategies have effects on reading achievement, they emerge most strongly in middle school. An examination of our results reveals that residential and public schools students are not different from each other on reading scores and language measures until middle school, with average age at 12 years. At this point, the residential school students, including those with hearing parents, begin to display higher means than the public school group. This suggests that schooling context may have a developmental effect, that is, for deaf students with hearing parents, attending a residential school at this age may introduce them to new reading strategies that derive from signing skill. In addition, the fact of a preponderance of one set of techniques at one setting is of interest since this suggests that features of school settings might contribute to different ways of organizing reading instruction.

Individual reading strategies

Additionally, the study uncovered further evidence (albeit indirect) of cultivation of reading skills among in young deaf readers from an analysis of deaf students' on-line reading behavior. This study had two related goals; to go beyond the deaf students' reading scores to seek students' observable strategies for approaching print and second, to determine deaf children's exposure to patterns for exploiting fingerspelling and initialized signs during instruction. Accordingly, students' reading behavior was observed in relation to what we knew about the language instruction they receive in their schools, derived from the classroom discourse study.

Reading behavior data was generated by an aided read and re-tell activity. With teachers' assistance, stories were selected at, or a bit above, each child's reading level. The students were videotaped reading the story, signing "aloud" (with